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ABSTRACT

This study investigated techniques for supporting college students' self-regulation within a core course in child development. The course incorporated Web-based instructional elements as ancillary instruction. Regularly scheduled class meetings occurred approximately twice weekly, highlighting various presentation methods to illustrate materials offered through both the Web page and supplemental materials. The course incorporated ideas gained through a review of the literature on self-regulation and metacognition. Nine self-regulation strategies were the focus for development of the Web page (e.g., keeping records and monitoring, reviewing notes, and seeking teacher assistance). The Web site included structured activities to encourage self-directed learning, a self-assessment inventory of self-regulatory learning skills, and additional tools for planning, monitoring, and evaluating learning. Data were collected on whether students desired support for additional strategies, whether their self-regulation strategies changed over the semester, and what strategies were most effective. Overall, students wanted the site to include the capacity to monitor grades online, a goal checklist, and elaborate feedback in testing situations. Students' self-efficacy and self-regulation increased and anxiety decreased over time. The most effective learning strategies were reviewing notes, keeping records, and self-evaluating. (Contains 24 references, 5 figures, and 5 tables.) (SM)

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Strategies to Support Self-directed Learning in a Web-based Course

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The number of courses delivered via the World Wide Web to distant learners is increasing rapidly, but courses delivered through distance education often have a high attrition rate; this attrition rate is due, in part, upon individual student characteristics. Success in these courses often is dependent upon students' abilities to be successful in directing their own learning efforts. In self-directed learning, an individual student "works with instructional materials on his or her own time, without direct supervision or guidance from either instructor or fellow students" (Keirns, 1999, p.1).

In recent years, discussions of "self-directed learning" have focused on the skills and abilities which individuals employ to successfully self-regulate their learning (Keirns, 1999). This paper describes a structured self-regulation protocol designed to foster and promote active self-regulated learning among students enrolled in a web-based course in Child Development and Family Studies. It also describes two studies designed to determine how students use the support strategies incorporated in the web site, whether students desire additional support tools, and the effects of the strategies on their self-regulation skills.

Zimmerman defines self-regulated learners as "metacognitively, motivationally, or behaviorally active promoters of their academic achievement' (1986, p.308). Learners who utilize self-regulation strategies are aware that certain strategies may somehow enhance their ability to achieve desired goals or parts of goals prescribed by a learning activity (Zimmerman,1989). A large cadre of strategies may be utilized for the self-regulation of learning activities (Zimmerman, 1989; Zimmerman & Martinez-Pons, 1986), and the outcome of the incorporation of these activities may be measured in changes in achievement, skill development, or in the change in the level of self-regulation itself.

The literature on developing self-regulated learners outlines three components of self-directed learning: the planning, monitoring, and evaluating of one's learning activities (Ertmer & Newby, 1996). Learners must plan, monitor, and evaluate their motivation, cognitive skills, and environmental factors.

- During the *planning* stage, learners determine the goal of the lesson. They identify what they already know about the task, and develop a learning strategy. They should determine what is required by the learning task, and plan their study time and conditions.
- During the *monitoring* stage, learners determine whether the strategies they have chosen are working for the task. They reflect on whether they are making sufficient progress toward their learning goals.
- During the *evaluating* stage in self-regulated learning, students evaluate how well their approach worked with the task. They reflect on how well they met their goal, and determine whether they should modify their strategies in the future.

Although these components account for much of the metacognitive activity that surrounds learning, they do not completely account for learning. Between the planning and monitoring stages, learners must take action. Ertmer and Newby's (1996) model of the expert learner suggests that during the learning process, expert learners use their metacognitive knowledge of cognitive, motivational, and/or environmental strategies to choose those strategies that may be most appropriate for a given learning task.

Zimmerman and Marinez-Pons (1986) provide insight on strategies that may be employed as learners take action. Zimmerman and Marinez-Pons interviewed students to determine the self-regulation strategies used by both gifted students and students who were not in an advanced academic track. Zimmerman and Marinez-Pons' s research identified the following 14 strategies. In the list below, some of the categories are combined because of the similarity among some strategies.

Table 1: Self-regulation Learning Strategies (Zimmerman and Martinez-Pons, 1986)

Strategy	Description
1. Self-evaluation	Student-initiated evaluations of the quality or progress of their work.
2. Organizing and transforming	Student-initiated overt or covert rearrangement of instructional materials to improve learning.
3. Goal-setting and planning	Setting of educational goals or subgoals and planning for sequencing, timing, and completing activities related to these goals by the student.
4. Seeking information	Student-initiated efforts to secure further task information from nonsocial sources when undertaking an assignment.
5. Keeping records and monitoring	Student-initiated efforts to record events or results.
6. Environmental structuring	Student-initiated efforts to select or arrange the physical setting to make learning easier.
7. Self-consequences	Student arrangement or imagination of rewards or punishment for success or failure.
8. Rehearsal and memorizing	Student-initiated efforts to memorize material by overt or covert practice.
9-11. Seeking social assistance	Student-initiated efforts to solicit help from peers (9), teachers (10), and adults (11).
12-14. Reviewing records	Student-initiated efforts to reread tests (12), notes (13), or textbooks (14) to prepare for class for testing.

Merging Zimmerman and Marinez-Pons's (1986) strategies with the components of self-regulation identified by other researchers provides a guide to how learners can successfully direct their own learning. The strategies of goal setting and planning, environmental structuring, and determining self-consequences are involved in the *planning* stage of self-regulation. Although not included by Ertmer and Newby (1996), an *action* stage must follow the initial planning stage in which strategies are applied to skill or knowledge acquisition. The strategies of organizing and transforming information, seeking information, rehearsal and memorizing, and seeking social assistance are related to this action stage. Of course, each of these "actions" can be planned during the former stage in self-directed learning. The action and *monitoring* stages coexist in a recursive manner and strategy choice in one stage may be influenced or altered by the results of strategies in the other. Keeping records and monitoring as well as the reviewing of a variety of records are monitoring stage strategies. The one strategy identified by Zimmerman and Martinez-

Pons that best relates to the *evaluation* stage is self-evaluation; however, reviewing records may also involve evaluation.

Table 2: Stages and strategies for self-regulated learning

Stages in self-directed learning	Zimmerman & Marinez-Pons Strategies
Plan	Goal setting and planning Environmental structuring Determining self-consequences
Take Action	Organizing and transforming information Seeking information Rehearsal and memorizing Seeking social assistance
Monitor	Keeping records and monitoring Reviewing records
Evaluate	Self-evaluation

Research also suggests that the tasks inherent in expert learning can be modeled and demonstrated by teachers and instructional systems and thus provide the scaffolding structures necessary for students to learn and internalize self-regulation strategies (Bruer, 1994, Simons, 1993). The goal then becomes one of transferring the regulation of the learning process from the control of the instructional system and the instructor to the internalized control of the learner, through extensive practice and feedback (Ertmer & Newby, 1996). Consistent with the idea of scaffolding, support for developing strategies of self-regulation should be available to students when they need it, they should be provided various "depths" or levels of support, and students should be able to select the level of support they need, when they need it.

Purpose and participants

The purpose of this research was to determine techniques of supporting learners' self-regulation within the context of a large university core course in Child Development. The course incorporated web-based instructional elements as ancillary instruction. Regularly scheduled class meetings occurred up to two times a week, focusing on various presentation methods to illustrate materials presented through both the web page and supplemental materials. Students were not required to attend all class meetings due to the information available on the web site; however, all students attended class four times during the semester to take 60-question multiple-choice tests. The course typically enrolls approximately 250 students each semester.

The majority of students who enroll in this course are freshmen. We recognized that students had much more structure in high school than in college, and that freshmen may not be able to manage the freedom and responsibility of a course where the primary content is offered over the web and where class attendance is optional. Thus, we designed the materials to

incorporate techniques that would encourage students to become more self-directed and active in their learning.

Materials

To foster and promote active self-regulated learning among students, we incorporated ideas gained through a review of the literature on self-regulation and metacognition as critical elements in the design of the web site for a course on Child Development. Nine self-regulation learning strategies served as a focus for the development of the course web pages. Five of these nine strategies are noted as strategies most often utilized by students with high levels of perceived self-regulation (Risemberg & Zimmerman, 1992; Zimmerman & Martinez-Pons, 1986, 1990). They include: a) keeping records and monitoring, b) reviewing notes, c) organizing and transforming, d) seeking information from nonsocial sources, and e) seeking teacher assistance. Additional strategies supported by the design of the web site include a) reviewing tests, b) reviewing textbooks, c) self-evaluation, and d) goal setting, which finds further support in the literature describing the self-regulation process (Ames & Archer, 1986; Butler, 1997; Ertmer & Schunk, 1997; Miller, Behrens, Greene & Newman, 1993). Although the strategies of environmental restructuring, self-consequences, rehearsal and memorizing, and seeking assistance from peers and other adults were not directly supported on the web site, we provided suggestions to students as to how to incorporate these strategies in their learning efforts. As described above, these strategies support the planning, monitoring, and evaluating components of self-regulation.

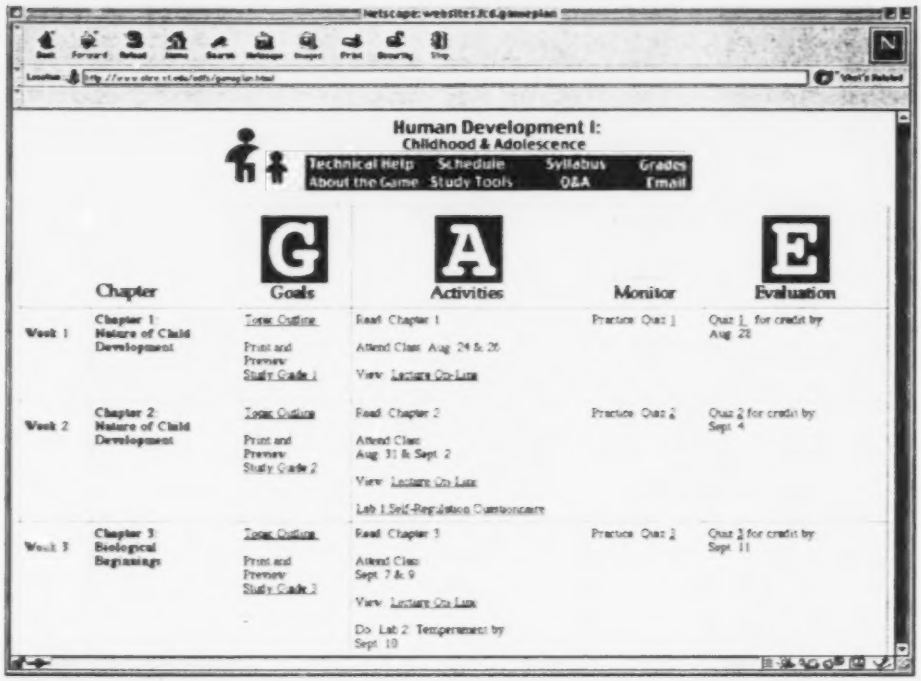
Our intention has been to provide the necessary support for fostering the development of self-regulation skills in a unique way by providing students with an on-line protocol for self-regulation. The site consists of a structured arrangement of activities to encourage self-directed learning (the GAME PLAN), a self-assessment inventory of self-regulatory learning skills, and additional tools to assist students in planning, monitoring, and evaluating their learning. The support activities are provided for those who choose to use them, yet the site allows learners to progress through the instruction without accessing any of the activities included to assist them in managing their learning. The course grade is based solely on quizzes to assess their learning at the end of each chapter, lab activities, and four equally weighted in-class examinations; all other activities are completely optional, and are provided simply to model and provide practice in the skills exhibited by successful self-regulated learners.

The GAME plan

We present a model for self-regulated learning, and through the arrangement of our web site, we provide opportunities to practice the skills and processes employed by successful self-directed learners. We have translated recommendations from the literature into an easy to remember acronym: the GAME (Goal, Action, Monitor, and Evaluate) Plan (See Figure 1). Course materials and activities associated with **Goal** setting include topic outlines and study guides. The study guides consist of open-ended outlines which structure the student's notetaking. Students take **Action** by attending class, reading the textbook, viewing a PowerPoint "lecture" on- line, completing the study guides, and participating in lab activities. Students **Monitor** their actions by completing practice quizzes, consisting of 10 questions randomly selected from a test item bank, as often as they like. Feedback following each response informs

students whether the answer is correct, and if incorrect, informs them of the correct response. Finally, students **Evaluate** their actions by completing an on-line quiz for credit and reviewing their grades.

Figure 1: The GAME plan



Self-assessment

According to Weinstein and Van Mater Stone (1993), self-regulating learners require knowledge about themselves as learners, knowledge about the learning task, knowledge about a wide variety of strategies, and knowledge about the content to learn successfully. The resources provided in the GAME plan provide students with information about the learning task, through the topic outlines and study guides, and the content, through the textbook and on-line lectures. The self-assessment activity increases students' awareness of themselves as "learners" and presents information on a wide variety of strategies that may help them become successful in their learning tasks.

Students gain an increased awareness of their employment of self-regulation strategies by completing a "Motivated Strategies for Learning Questionnaire" (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991) early in the class. The MSLQ is designed to assess college student's motivational orientations and their use of different learning strategies. Sample statements from the index include "If I can, I want to get better grades in this class than most of the other students" and "When I take tests I think of the consequences of failing." These statements are rated on a seven-point scale ranging from "very true" to "not true at all".

Based on their responses, students receive individualized feedback as to their strengths and weaknesses in the areas of intrinsic motivation; extrinsic motivation; interest in topic; task

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value; expectancy for success; test anxiety; use of cognitive strategies such as rehearsal, elaboration, organization; metacognitive skills; and their time and resource management (see Figure 2). Students are referred to supplemental information on developing their skills in areas of need dependent upon their scores. These supplemental pages contain an explanation of the term, suggestions for improving or developing skills in that area, and annotated links to other web sites devoted to developing the target skill (see Figure 3).

Figure 2: Student feedback

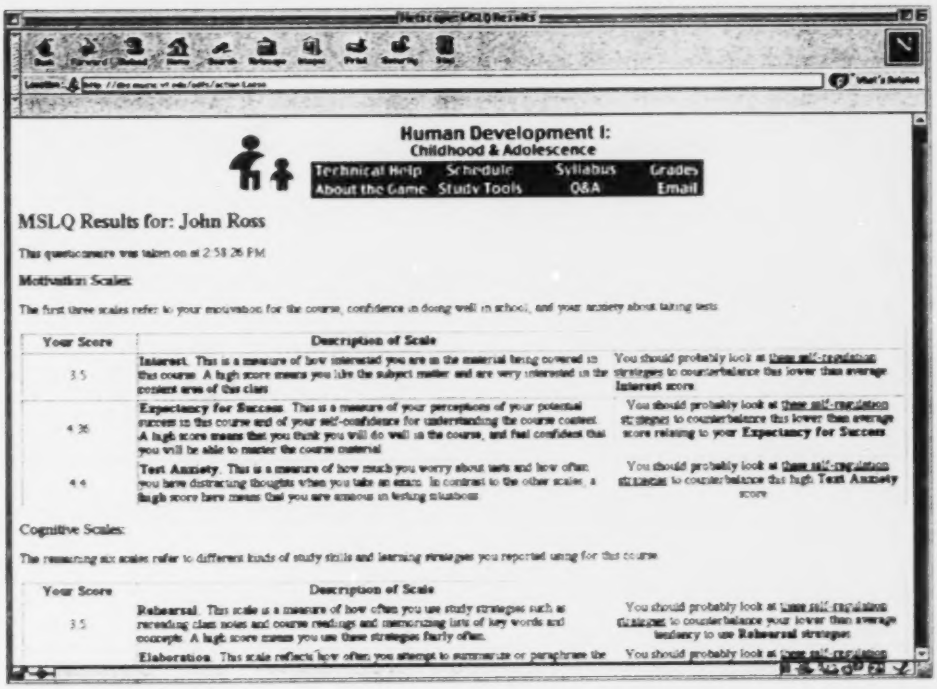

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Figure 3: Supplemental tips

Motivation: Interest
Please use your BACK key to return to your MSLQ results.
This is a measure of how interested you are in the material being covered in this course. A high score means you like the subject matter and are very interested in the content areas of this class.
What you can do RIGHT NOW: Skim the table of contents of the class textbook or take a look at the course syllabus (the Game Plan) and make a list of the three topics that most interest you and of the three topics that least interest you. Pay particular attention to these topics.
• What is it about the three most interesting topics that makes you like them so much?
• What is it about the other three topics that makes them uninteresting?
• Can you find any of the characteristics of the three most interesting topics in the three least interesting topics?
If you identify what it is about the three most interesting topics that makes you like them so much, you may be able to apply what you found to the three least interesting ones, and perhaps you'll find that those uninteresting topics aren't so uninteresting after all!
Intrinsic Goal Orientation | Extrinsic Goal Orientation | Task Value | Top of Page
Motivational Strategies: Extrinsic Goal Orientation
Goals are a way of explaining your reasons for engaging in learning tasks, such as the activities in this course. If you see yourself as participating in academic activities because you perceive them as challenging, because they stimulate your curiosity, or because you enjoy engaging academic activities that provoke deep and thoughtful involvement on your part, then your goals are mastery oriented and can be characterized as intrinsic goals.
Some research indicates that developing intrinsic goals that lead to mastery learning results in deeper levels of understanding of material to be learned than do performance goals. However, other research has shown that it may be advantageous for college students to have both intrinsic and extrinsic goal orientations.

First Study: How do students use the support strategies embedded in the web-site?

We were initially interested in determining how students used the support strategies embedded in the course web-site. During the Spring 1997 semester, fifteen students were randomly selected from the students enrolled in the course who indicated that they had used the computer for two years or less (Turner, 1998). These students participated in individual interviews where they were asked to describe how they used the course web site and how they imagine the ideal course web site.

Using transcriptions of the interviews, two researchers examined the data for common themes. The data clustered into four categories: patterns of use, user suggestions, likes, and dislikes. A qualitative analysis of the interview data revealed that most students follow a specific learning procedure. Students learn the course content by reading the goals for the week, printing the study guides, viewing the lecture on line and/or reading the book to complete the study guide, and completing lab assignments. Then they take the practice quiz several times. When they feel confident that they know the material, they take the on-line quiz.

Based on the students' desire for a simple but effective web site, we simplified the graphical layout and site interface and eliminated features that were seldom used by the students. Students preferred to communicate and receive announcements via a listserv rather than through the course web page; thus, we eliminated the chat room, threaded discussion forum, and announcements from the course web page. In addition, they seldom used the technical help section or on-line journal; therefore, the technical help section was scaled back and the on-line journal was eliminated from the current version of the web site.

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The results of the student interviews revealed that the structured protocol of the course facilitated skills that can be characterized as self-regulating. Students *plan* their learning by reviewing the goals for the week. They use the study guide to organize and transform their learning from the book or the on-line lecture. They *monitor* their own learning by completing the practice quizzes. And finally, they *evaluate* their learning by completing a graded quiz and reviewing their grades. However, we wanted to determine whether there were changes in the students' self-regulation over the course of the semester. And although the interviews revealed that the web-based strategies were effective in supporting self-directed learning, we wanted to determine which strategies were perceived as most effective and whether additional strategies were needed by the students. Thus, we conducted a second study during the Fall of 1998.

The second study

For the second study, a series of data were collected from the 260 students enrolled in the course. A stratified random sample of 35 students was selected from 117 participants who completed all data collection administrations. Stratification was based upon whether the course was a major requirement or elective, and upon the participant's year in school. Bias may exist when considering that these 117 participants may have been more motivated to complete the on-line data collection procedures or more adaptive to the learning environment; however, students who provided data for the purpose of the study neither gained nor lost advantage in the course in the form of recognition or grades

Data from participants came from six sources throughout the semester and are fully elaborated upon below. Three of these sources are primary data sources and include the "Motivated Strategies for Learning Questionnaire" (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991), comments generated by questions on the class listserv, and an exit questionnaire at the conclusion of the semester.

Research Question 1: Do students desire support for additional strategies?

A series of three questions was posted to the course web page during the third, fifth, and seventh weeks. These questions were analyzed utilizing domain analysis to determine the effectiveness of the existing regulation components imposed by the web site and the need for additional components to meet participant goals. Domain analysis, as described by Spradley (1980), is a search for patterns within a culture. In this case, the culture was the interaction by the participants within and relating to the use of the course web site. Like patterns comprise cultural domains or a group of different objects treated equivalently.

Through the analysis of e-mail responses and these listserv questions, terms given by the participants and the relationships implied among these terms were utilized to describe new components intended for the web site. New components included the capacity to monitor grades (grades on-line), establish date-based goal reminders (goal checklist), and elaborative feedback in testing situations.

Grades on-line. The results of domain analysis of the responses to the first set of listserv questions revealed that students desired to check their cumulative grades at any time. During the fourth week of the semester, a "Grades on-line" feature was added.

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Figure 4: Grades-on-line

Grade entry for: John Ross

Number	Quiz Grades Quizzes are worth 10% your final grade	Lab Grades Labs are worth 10% your final grade	Exam Grades Exams are worth 80% your final grade
1	5	10	100
2	9	10	0
3	0	10	97
4	7	0	0
5	8	10	
6	6	10	
7	0	10	
9	0		
10	0		
11	0		
12	10		
14	10		
15	0		
16	0		
17	0		
Averages:	3.66666666666667	8.57142857142857	49.25
		Your grade at this point =	[redacted]

The Goals Checklist . Following the second set of listserv questions, a goals checklist feature was added. This feature allows student to create their own time-dependent goals which are then e-mailed to them via an automated system (see Figure 5).

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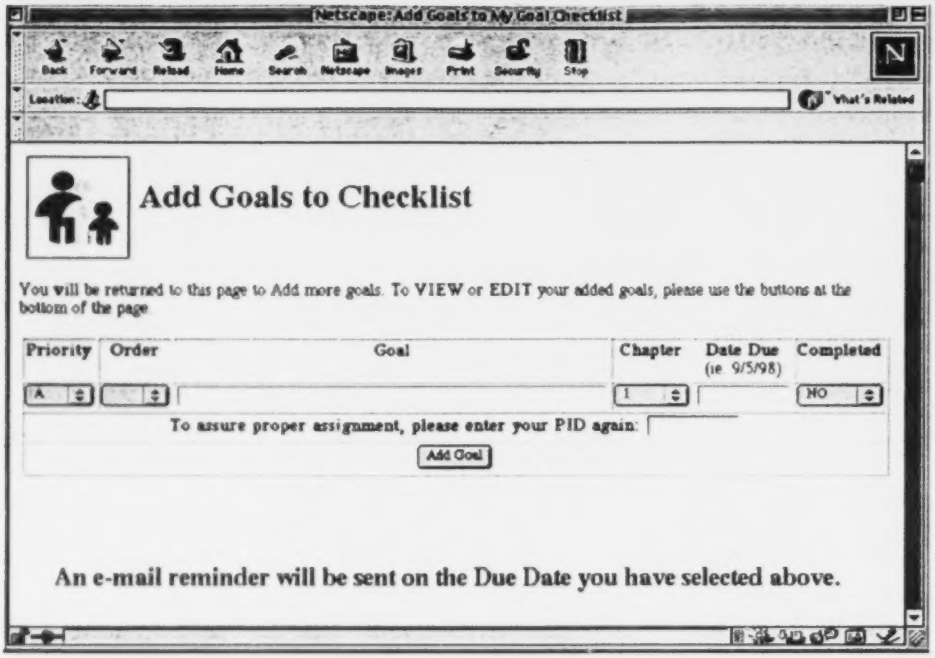
Figure 5: Goals checklist



Elaboration. The results of the domain analysis of listserv questions suggested participant dissatisfaction with the current quizzing system. During practice quizzes, participants received confirmatory feedback after answering each question. Following the completion of the graded quiz, participants were informed only of the number of questions answered correctly. No indication was given of which questions were answered correctly or the correct responses to missed questions. An attempt was made to shift to an on-line testing environment called "Whiz Quiz" in order to provide participants with the elaborative feedback they desired. The Whiz Quiz format was utilized for the administration of two graded quizzes; however, the reporting of the grades to the instructor proved to be unreliable. Unfortunately, the Whiz Quiz format was dropped, and a suitable replacement was not found within the remainder of the course.

The table below outlines the administration of the data collection instruments and the subsequent incorporation of additional support strategies.

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Table 3: Sequence of activities

Week	Action
2	Students completed MSLQ
3	Students completed first set of listserv questions
4	Grades on-line added
5	Students completed second set of listserv questions
6	Goal checklist added
6	Students completed third set of listserv questions
9	Elaborative feedback added
9	Second administration of MSLQ
9	Students completed Exit questionnaire
16	Students completed third administration of MSLQ
16	Students completed second administration of Exit questionnaire

Research question 2: Are there changes in self-regulation over the course of the semester?.

Participants completed the "Motivated Strategies for Learning Questionnaire" (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991), an index of self-regulation strategy use during the second, ninth, and final weeks of the semester. Based upon the general cognitive view of motivation and learning strategies, the MSLQ is designed to assess college students' motivational orientations and their uses of different learning strategies for a college course. The MSLQ contains 15 subscales that make up two major sections concerning motivation and learning strategies selection, respectively. The motivation section consists of 31 items that assess student goals and value beliefs for a course, beliefs about their skills to succeed in a course, and test anxiety. The learning strategies section contains 31 items regarding student use of cognitive and metacognitive learning strategies. The second section also includes 19 items concerning student management of different resources. The subscales are designed to be modular and adaptable to individual courses (Pintrich, Smith, Garcia, & McKeachie, 1991). Results from the MSLQ were analyzed using a series of paired t-tests.

A series of paired samples two-tailed t-tests indicated a significant difference in three of the 15 subscales in the MSLQ (Table 3). Mean scores for the stratified random sample for the subscale measuring self-efficacy for learning and performance were significantly greater for the third and final administration of the MSLQ over both the first and second administrations. Mean scores for test anxiety measurements showed a significant decrease between each subsequent administration of the index. Scores for the test anxiety subscale are read in opposition from the remaining scales; a low score indicates a lower perception of test anxiety. Mean scores for the subscale measuring metacognitive self-regulation increased significantly between the first and third administrations of the index. An alpha level of $p<.05$ was used on all tests.

Table 4: Motivated Strategies for Learning Questionnaire subscale results

Subscale	First		Second		Third		p		
	M	SD	M	SD	M	SD	1:2	2:3	1:3
Self-efficacy for learning and performance	5.863	.847	5.290	.881	6.248	.727	.526	*.001	*.001
Test anxiety	4.029	1.397	3.531	1.525	3.164	1.483	*.025	*.015	*.000
Metacognitive self-regulation	4.453	.929	4.592	.944	4.809	1.037	.101	.035	*.006

Note. df for all tests = 34; N = 35
* indicates significance

Research question 3: Which strategies are most effective?

Data were collected through a series of listserv questions and an exit questionnaire. Questions were posted to the class listserv three times during the semester. Students completed an exit questionnaire at two points in the semester. Students responded to open-ended and Likert-type scale questions about usage patterns of computes in general and the course web site in specific. Responses to the Likert-type scale items were analyzed using paired sample t-tests and frequency counts. Responses to open-ended questions were analyzed though domain analysis.

When asked to indicate which *one* learning strategy was used most often from the self-regulation learning strategies addressed in this study, members of the stratified, random sample (N = 35) self-reported that reviewing notes was the most common. Domain analyses of the responses to the listserv questions concerning this same topic differ, however. Keeping records and self-evaluation were the learning strategies cited most often in this analysis.

When asked to rate individual components of the course web site, participants indicated the practice quizzes (M = 4.89) were the most helpful component of the web site, with the goal checklist (M = 1.85) being the least helpful. Categories ranged in a Likert-type scale between zero and five and included: a negative effect (0), no effect (1), little effect (2), moderate effect (3), highly effective (4), and most effective (5). These findings were supported by the analysis of free responses on the exit questionnaire. Participants again indicated that the practice quizzes were the "most beneficial" (51.4%) component of the web site. Both the study guides and lectures on-line ranked second (24.3%). When asked which component was the "least helpful," the goal checklist was cited most often (24.3%).

Student ratings of the grades on-line component was high, with the responses from the second administration of the exit questionnaire (M = 2.88) significantly higher than the first administration of the exit questionnaire (M = 2.43).

Conclusions and discussion

The web site is designed to support students in developing effective study strategies while learning the course content. It is intended to scaffold them while they learn the skills of

self-regulation critical for active, self-directed learning. The strategies provided by the site are summarized in the following table.

Table 5: Summary of strategies

Strategy	Web site support
1. Self-evaluation	Practice quizzes provided for self-evaluation and monitoring learning
2. Organizing and transforming	Grid interface and consistent layout imposed structure Study guide provided open-ended outline for completion by students
3. Goal setting and planning	"GAME" acronym applied to grid interface implies instructor goals Goals, study time and conditions can be entered in the Goal checklist Topic outline & study guide indicate what students need to know
4. Seeking information	Text-book pages are indicated "Lectures" are available on-line
5. Keeping records and monitoring	Cumulative grades are posted on–line Printer-friendly page options promote record keeping
6. Environmental structuring	Free access to all materials promotes greatest amount of learner control Tips on arranging time and study environment are accessible from the self-regulation questionnaire
7. Self-consequences	Tips on controlling learning beliefs, increasing self-efficacy, strategic regulation of effort, increasing intrinsic and extrinsic motivation, decreasing test anxiety, and increasing task value are accessible from the self-regulation questionnaire
8. Rehearsal and memorizing	Tips on rehearsal, elaboration, organization of learning materials, critical thinking, and metacognitive strategies are accessible from the self-regulation questionnaire
9-11 Seeking social assistance	Tips on peer learning strategies, and seeking help from others are accessible from the self-regulation questionnaire E-mailing the instructor supports seeking assistance from instructor
12-14 Reviewing records	Study guides, lectures on line, and practice quizzes are available at all times for review. Printer-friendly page options support record keeping

An analysis of learning strategy use indicated that the four most commonly utilized learning strategies included keeping records, self-evaluation, setting goals, and pacing (Ross,

1999). The lines delineating learning strategies are not distinct, nor are the strategies mutually exclusive. Keeping records was most often mentioned. This strategy may be considered both a monitoring and evaluating strategy. Combined with the practice quiz activity, self-evaluation was a common learning strategy employed by users of the site.

Observations of use of the GAME Plan web site indicate that hypermedia may better promote the use of effective learning strategies by supporting the capability for students to keep records, either electronically or through hard-copy documentation, and providing the opportunity for self-evaluative activities. The very nature of web-based environments allows for a great flexibility in pacing, but consideration should be given to combining this flexibility with goal-setting behavior either through design-imposed goals similar to the layout of this web site or a checklist component allowing self-imposed goals by the student.

When considering all aspects of review, such as reviewing notes, textbooks, media, and tests, a supercategory relating to reviewing would have been the most common learning strategy. Current findings in the literature support the effects of reviewing strategies. The constant monitoring of feedback provided by the learning environment, feedback which is obtained through the reviewing process, helps to determine the effectiveness of current strategies and can result in the completion, elimination, or alteration of goals or selection and intensity of further learning strategies (Butler & Winne, 1995; Ertmer & Schunk, 1997; Zimmerman, 1989, 1990). Designers are encouraged to incorporate greater learner control in hypermedia if only to allow for this learning strategy. One participant commented, "I also like the fact that you can go over the lectures and all the information more than once just in case you missed information." When asked what improvements could be made to the site, an additional participant commented,

> I don't have any suggestions for improving the web site. It is very simple to understand and is a good way for me to understand the material, because if I don't understand something, I can always go back to the slides and read it over again.

The apparently simple, yet consistent, layout of the web site also contributed to goal-setting behavior among the participants. Said one participant, "I think that this web site is the best one that I visit out of all of my classes. It's easy to follow and very informative." Although the layout of the web site appears to be simple, remember that the site utilized during the study was the result of several years of development, analysis, and revision. This revision process led to the decreased use of graphics and other media and relied upon consistency to provide cues and promote the use of successful learning strategies by the participants. Consistency is exhibited both in layout and in the sequencing of instructional events implied by the layout. While participants described the web site as "simple," and it may appear so visually, the site capitalizes on key self-regulation principles that guide student learning through goal-directed behaviors which imply an effective sequence and promote the use of successful learning strategies. Students have repeatedly commented positively on the organization of the web site.

> "I really like the way that the web page is designed. It is easy to understand what needs to be done this week and that makes it easier for me to plan my schedule for studying. At the beginning of the week, I plan out when I am going to study and the using the lectures and study guides is extremely helpful."

Noticeably absent are the strategies of seeking information from social sources and seeking teacher assistance. Perhaps due to the nature of the web-based environment, participants completed many activities in isolation. Socialization could occur during class discussions or perhaps working on-line in a computer lab or with a friend; however, many participants indicated they completed their on-line activities at their own pace at their own leisure. This isolation decreased the opportunity for seeking information elsewhere or asking for assistance from the teacher; however, the participants indicated that sending electronic mail to the professor was a "highly effective" component of the web site.

Observations of student use of this web site support previous findings in the literature that self-regulating tasks may be more significant in reducing disorientation in hypermedia than programming constraints and "helper" items such as system maps (Beasley & Waugh, 1995). Stanton and Baber's (1994) suggestion that disorientation in hypermedia is the result of poor design is not only supported in these observations, but suggests that simple, consistent design can effectively support learners and promote successful learning strategies without the addition of complex, superfluous, programming artifacts. When asked to compare the current web site with other web sites and multimedia products, one participant stated,

> I think that this website is the most useful out of all the websites I have for my other classes. It includes everything I need and would want to know. For example, it has practice quizzes for me to evaluate what I need to study more and my grades so I can keep up with my progress in this class.

Although the goals of this course focus on learning information at the knowledge, comprehension, application, and analysis stages in Bloom's (Bloom, et. al., 1956) taxonomy of learning outcomes, strategies similar to the ones we have embedded in this web site could support higher-level learning outcomes. Future research should explore the effectiveness embedding strategies that support self-regulation into environments designed to facilitate other types of learning outcomes.

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